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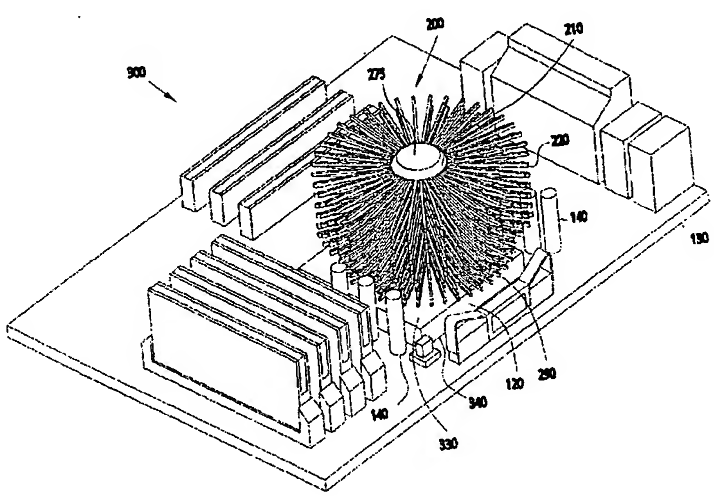

(57) Abstract: An enhanced heat dissipation device to extract heat from an integrated circuit device includes a thermally conductive core having upper and lower outer surface areas. The device further includes a first array of radially extending pin fin structures. The first array is thermally coupled to the upper surface area such that a cooling medium introduced around the core and the first array creates an omni-directional flow around the first array and the core to enhance heat dissipation from the integrated circuit device. The core including the first array and the lower surface area are of sufficient size to allow components on a motherboard to encroach onto the integrated circuit device when the heat dissipation device is mounted onto the integrated circuit device.

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HIGH PERFORMANCE HEAT SINK CONFIGURATIONS FOR USE IN HIGH DENSITY PACKAGING APPLICATIONS

Technical Field

This invention relates generally to a heat dissipation system and method for an integrated circuit assembly, and more particularly to a system and method of dissipating heat from an integrated circuit device.

Background

Integrated circuit devices, microprocessors and other related computer components are becoming more and more powerful with increasing capabilities, resulting in increasing packaging densities and amounts of heat generated from these components. Packaged units and integrated circuit device sizes of these components are decreasing or remaining the same, but the amount of heat energy given off by these components per unit volume, mass, surface area or any other such metric is increasing. In current packaging techniques, heat sinks typically consist of a flat base plate, which is mounted onto the integrated circuit device on one side. The heat sinks further include an array of fins running perpendicular to the flat base plate on the other side. Generally, the integrated circuit devices (which are the heat sources) have a significantly smaller footprint size than the flat base plate of the heat sink. The flat base plate of the heat sink has a large footprint. The large footprint requires more motherboard real estate than the integrated circuit device in contact therewith. The larger size of the base plate causes the outermost part of the base plate that is not directly in contact with the integrated circuit device to have a significantly lower temperature than the part of the base plate that is directly in contact with the integrated circuit device. This results in the outermost part of the heat sink that is not directly in contact with the integrated circuit less efficient in dissipating heat into the cooling air.

Furthermore, as computer-related equipment becomes more powerful, more components are being placed inside the equipment and on the motherboard which further requires more motherboard real estate. In addition, the base plate of prior art heat sink designs is at the same level as the integrated circuit device to which it is attached. Consequently, the flat base plate configuration of the heat sink generally ends up consuming more motherboard real estate than the integrated circuit device on which it is mounted. As a result, the larger footprint size of the base plate prevents other motherboard components, such as low-cost capacitors, from encroaching around or on the microprocessor. Thus, the large amounts of

heat produced by many of such integrated circuits, and the increasing demand for motherboard real estate need to be taken into consideration when designing the integrated circuit mounting and packaging devices.

For the reasons stated above, and for other reasons stated below which will become apparent to those skilled in the art upon reading and understanding the present specification, there is a need in the art for an enhanced heat dissipation device and method that conserve motherboard real estate and allows electronic components to encroach on and around the microprocessor.

Brief Description of the Drawings

Figure 1 is an isometric view of a prior art heat sink attached to a microprocessor on an assembled motherboard.

Figure 2 is an isometric view of one embodiment of an enhanced heat dissipation device according to the present invention.

Figure 3 is an isometric view showing the enhanced heat dissipation device of Figure 2 attached to a microprocessor on an assembled motherboard.

Figure 4 is an isometric view of another embodiment of an enhanced heat dissipation device according to the present invention.

Figure 5 is an isometric view showing the enhanced heat dissipation device of Figure 4 attached to a microprocessor on an assembled motherboard.

Figure 6 is an isometric view of another embodiment of an enhanced heat dissipation device according to the present invention.

Figure 7 is an isometric view showing the enhanced heat dissipation device of Figure 6 attached to a microprocessor on an assembled motherboard.

Detailed Description

In the following detailed description of the embodiments, reference is made to the accompanying drawings that illustrate the present invention and its practice. In the drawings, like numerals describe substantially similar components throughout the several views. These embodiments are described in sufficient detail to enable those skilled in the art to practice the invention. Other embodiments may be utilized and structural, logical, and electrical changes may be made without departing from the scope of the present invention. Moreover, it is to be understood that the various embodiments of the invention, although different, are not necessarily mutually exclusive. For example, a particular feature, structure, or characteristic described in one embodiment may be included in other embodiments. The following detailed description is, therefore, not to be

taken in a limiting sense, and the scope of the present invention is defined only by the appended claims, along with the full scope of equivalents to which such claims are entitled.

This document describes, among other things, an enhanced heat dissipation device that allows electronic components to encroach around and on a microprocessor while maintaining high performance and cost effectiveness by leveraging currently enabled high-volume manufacturing techniques.

Figure 1 shows an isometric view 100 of a prior art heat sink 110 mounted on a microprocessor 120 of an assembled motherboard 130. Also, shown in Figure 1 are low-cost capacitors 140 mounted around the heat sink 110 and on the motherboard 130.

The prior art heat sink 100 has a flat base plate 150 including an array of fins 160 extending perpendicularly away from the flat base plate 150. This configuration of the heat sink 110 dictates the use of the flat base plate 110, with the array of fins 160 for dissipating heat from the microprocessor 120. Increasing the heat dissipation using the prior art heat sink 110 shown in Figure 1, generally requires enlarging the surface area of the flat base plate 150 and/or the array of fins 160. This in turn results in consuming more motherboard real estate. Generally, the microprocessor 120 (which is the heat source) has a smaller footprint size than the flat base plate 150 configuration of the heat sink 110 shown in Figure 1. A larger footprint size of the flat base plate 150 can cause the outermost part of the flat base plate 150 (the portion that is not directly in contact with the integrated circuit device) to have a significantly lower temperature than the part of the flat base plate 150 that is directly in contact with the integrated circuit device. Consequently, the prior art heat sink 110 with the larger flat base plate 150 is not effective in dissipating heat from the integrated circuit device. Furthermore, the packaged units and integrated circuit device sizes are decreasing, while the amount of heat generated by these components is increasing. The prior art heat sink 110 configuration dictates that the array of fins 160 extend to the edge of the flat base plate 150 to extract heat from the integrated circuit device. Also, the prior art heat sink 110 requires increasing the size of the array of fins 160 to increase the heat dissipation. In order to enlarge the fins 120 laterally, the flat base plate 150 has to increase in size. Enlarging the flat base plate 150 consumes more motherboard real estate. Consuming more motherboard real estate is generally not a viable option in an environment where system packaging densities are increasing with each successive, higher performance, integrated circuit device generation. Also, the prior art heat sink

110 is at the same level as the integrated circuit device on which it is mounted. It can be seen in Figure 1, that the flat base plate 150 configuration of the prior art heat sink 110 mounted on the microprocessor 120 generally prevents other motherboard components, such as low-cost capacitors 140, from encroaching around the microprocessor 120.

Figure 2 is an isometric view of one embodiment of the enhanced heat dissipation device 200 according to the present invention. Shown in Figure 2 is the enhanced heat dissipation device 200 including a thermally conductive core 210, and a first array of radially extending pin fin structures 220. The pin structures can have cross- sectional shapes such as round, square, rectangle, elliptical, conical or any other suitable shape for dissipating heat. Also, shown in Figure 2 is the core 210 having upper and lower outer surface areas 230 and 240. The first array 220 is thermally coupled to the upper surface area 230 of the core 210 such that a cooling medium such as air introduced around the upper and lower surface areas 230 and 240 of the core 210 and the first array 220 creates an omni-directional flow around the core 210 and the first array to enhance heat dissipation from the heat sink 200. Figure 2 further shows an optional second array of radially extending pin fin structures 290 thermally coupled to the lower surface area 240 of the core 210 such that the cooling medium introduced around the second array also creates an omni-directional flow around the second array 290. Each of the pin structures can have a head to create a higher turbulent flow around the first and second arrays 220 and 290.

The core 210 has an axis 260. In some embodiments, the upper and lower surface areas 230 and 240 are parallel to the axis 260. The core 260 further has a base 270. In some embodiments, the base 270 is disposed in such a way that it is in close proximity to the lower surface area 240 and perpendicular to the axis 260. The upper and lower surface areas 230 and 240 can be concentric to the axis 260.

The first array 220 is thermally coupled to the upper surface area 230 such that components can be mounted around and in close proximity to the lower surface area 240 and below the first array 220 when the device 200 is mounted onto an integrated circuit device. In some embodiments, the components can encroach onto the integrated circuit device without mechanically interfering with the device 200.

The core 210 can be a solid body. The solid body can be cylindrical, conical, square, rectangular, or any other similar shape that facilitates in mounting onto the integrated circuit device and in attaching the first array 220 to

the upper surface area 230. The core 210 can include heat transport mediums such as one or more heat pipes, a liquid, a thermo-siphon, or other such heat transport medium that enhance heat dissipation from the integrated circuit device.

In some embodiments, the first array 220 has a first outer diameter 250 and the second array 290 has a second outer diameter 255. The second outer diameter 255 is less than the first outer diameter 250. The first array 220 has a first depth and the second array 290 has a second depth. The first and second outer diameters 250 and 255 including the first and second depths are of sufficient size to allow components to be mounted around and in close proximity to the integrated circuit device when the device is mounted on the integrated circuit device.

The second array 290 is thermally coupled to the lower core area 240 of the core 210 such that the cooling medium introduced around the first and second arrays 220 and 290 creates an omni-directional flow around the upper and lower surface areas 230 and 240 of the core 210 and the first and second arrays 220 and 290 to enhance heat dissipation from the heat sink 200. The device 200, including the core 210 and the first and second arrays 220 and 290, can be made from materials such as aluminum, copper, or any other materials that are capable of dissipating heat away from the integrated circuit device. The first and second arrays 220 and 290 can be formed to have outer shapes such as circular, square, rectangular, elliptical, conical or any other shape suitable for allowing components to encroach around and in close proximity to the first and second arrays 220 and 290.

Figure 3 is an isometric view 300 showing the enhanced heat dissipation device 200 shown in Figure 2, attached to the microprocessor 120 on an assembled motherboard 130. In the example embodiment shown in Figure 3, the microprocessor 120 has a front side 340 and a back side 330. The front side 340 is disposed across from the back side 330. The front side 340 is attached to the assembled motherboard 130 that has components such as low-cost capacitors 140 and other such electrical components. The base 270 shown in Figure 2, of the enhanced heat dissipation device 200, is attached to the back side 330 of the microprocessor 120. It can be seen from Figure 3 that the first and second arrays 220 and 290 are of sufficient size so as to allow low-cost capacitors 140 mounted on the assembled board 130 to encroach around the microprocessor 120. It can also be seen that the low-cost capacitors 140 are below the first array 220 and around the second array 290.

Also, it can be seen in Figure 3 that the first array 220 is larger than the

second array 290, thereby increasing the heat dissipation rate without increasing a footprint size of the base 270 of the heat dissipation device 200 any more than the back side 330 of the microprocessor 120. The coinciding footprint sizes of the base 270 of the heat dissipation device 200 and the back side 330 of the microprocessor 120 enables the base 270 and the back side 330 of the microprocessor 120 to have the same heat transfer rates. This in turn increases the efficiency of heat transfer between the base 270 and the back side 330 of the microprocessor 120.

The core 210 further has a top surface 275 disposed across from the base 270. In some embodiments, the top surface 275 is perpendicular to the axis 260 and is in close proximity to the first array 220. A heat transport medium can be attached to the top surface 275 to introduce a heat transfer medium 297 such as air in a direction shown in Figure 2. This creates an omni-directional flow around the core 210 and the first and second arrays 220 and 290 to enhance heat dissipation by the heat dissipation device 200. A heat transport medium 295 such as a heat pipe, or other such medium can be included in the core 210 to further enhance the heat transfer from the heat dissipation device 200.

In some embodiments, the enhanced heat dissipation device 200 is made of thermally conductive materials such as copper, aluminum, or any other such material capable of extracting heat away from the integrated circuit device. In some embodiments, the core 210 can include heat transport mediums such as one or more heat pipes, a liquid, a thermo-siphon, or other similar heat transport medium suitable for enhancing the extraction of heat from the integrated circuit device. In some embodiments, the first and second arrays 220 and 290 occupy a first and second volume of space, respectively around the upper and lower surface areas 230 and 240 such that the first volume is less than the second volume to permit components to be mounted on the circuit board 130 and below the first array 220.

Figure 4 is an isometric view of another embodiment of the enhanced heat dissipation device 400 according to the present invention. Shown in Figure 4 is the enhanced heat dissipation device 400 including the thermally conductive core 210, and a first array of radially extending substantially planar fin structures 420. Also, shown in Figure 4 is the core 210 having the upper and lower outer surface areas 230 and 240. The first array 420 is thermally coupled to the upper surface area 230 of the core 210 such that a cooling medium such as air introduced around the upper and lower surface areas 230 and 240 of the core 210 and the first array 420, creates a flow that is substantially parallel to the upper and lower

surface areas 230 and 240 and the first array 420 to enhance heat dissipation from the heat sink 400. Figure 4 further shows an optional second array of radially extending substantially planar fin structures 490 thermally coupled to the lower surface area 240 of the core 210 such that the cooling medium introduced around the first and second arrays 420 and 490 creates a flow that is substantially parallel to the upper and lower surface areas 230 and 240 and the first and second arrays 420 and 490.

The core 210 has an axis 260. The substantially planar fin structures of the first and second arrays 420 and 490 are thermally coupled to the upper and lower surface areas 230 and 240, respectively such that they are substantially parallel to the axis so that the cooling medium introduced around the core 210 and the first and second arrays 420 and 490, creates a flow substantially parallel to the axis 260 to enhance heat dissipation from the heat sink 400. In some embodiments, the first and second arrays 420 and 490 including the substantially planar fin structures are aligned and thermally coupled so that they form a single array as shown in Figure 4. In some embodiments, the upper and lower surface areas 230 and 240 are parallel to the axis 260. The core 260 further has a base 270. In some embodiments, the base 270 is disposed such a way that it is in close proximity to the lower surface area 240 and perpendicular to the axis 260. The upper and lower surface areas 230 and 240 can be concentric to the axis 260.

The first array 420 is thermally coupled to the upper surface area 230 such that components can be mounted around and in close proximity to the lower surface area 240 and below the first array 420 when the device 400 is mounted onto an integrated circuit device. In some embodiments, the components can encroach onto the integrated circuit device without mechanically interfering with the device 400.

The core 210 can be a solid body. The solid body can be cylindrical, conical, square, rectangular, or any other similar shape that facilitates in mounting onto the integrated circuit device and in attaching the first array 420 to the upper surface area 230. The core 210 can include heat transport mediums such as one or more heat pipes, a liquid, a thermo-siphon, or other such heat transport medium that enhance heat dissipation from the integrated circuit device.

The first array 420 has the first outer diameter 250 and the second array 490 has the second outer diameter 255. The second outer diameter 255 is less than the first outer diameter 250. The first array 420 has a first depth and the second array 490 has a second depth. The first and second outer diameters 250 and 255 including the first and second depths, are of sufficient size to allow

components to be mounted around and in close proximity to the integrated circuit device when the device is mounted on the integrated circuit device.

The second array 490 is thermally coupled to the lower core area 240 of the core 210 such that the cooling medium introduced creates an omni-directional flow around the upper and lower surface areas 230 and 240 of the core 210 and the first and second arrays 420 and 490 to enhance heat dissipation from the heat sink 400. The device 400, including the core 210 and the first and second arrays 420 and 490, can be made from materials such as aluminum, copper, or any other materials that are capable of dissipating heat away from the integrated circuit device. The first and second arrays 420 and 490 can be formed to have outer shapes such as circular, square, rectangular, elliptical, conical or any other shape suitable for allowing components to encroach around and in close proximity to the first and second arrays 420 and 490.

Figure 5 is an isometric view 500 showing the enhanced heat dissipation device 400 shown in Figure 4, attached to the microprocessor 120 on the assembled motherboard 130. In the example embodiment shown in Figure 5, the microprocessor 120 has a front side 340 and a back side 330. The front side 340 is disposed across from the back side 330. The front side 340 is attached to the assembled motherboard 130 having components such as low-cost capacitors 140 and other such electrical components. The base 270 shown in Figure 4, of the enhanced heat dissipation device 400 attached to the back side 330 of the microprocessor 120. It can be seen from Figure 4 that the first and second arrays 420 and 490 are of sufficient size so as to allow low-cost capacitors 140 mounted on the assembled board 130 to encroach around the microprocessor 120. It can also be seen that low-cost capacitors 140 are below the first array 420 and around the second array 490.

Also, it can be seen in Figure 4 that the first array 420 is larger than the second array 490, thereby increasing the heat dissipation rate without increasing a footprint size of the base 270 of the heat dissipation device 400 any more than the back side 330 of the microprocessor 120. The coinciding footprint sizes of the base 270 of the heat dissipation device 400 and the back side 330 of the microprocessor 120 enables the base 270 and the back side 330 of the microprocessor 120 to have same heat transfer rates. This in turn increases the efficiency of heat transfer between the base 270 and the back side 330 of the microprocessor 120.

The core 210 further has the top surface 275 disposed across from the base 270. In some embodiments, the top surface 275 is perpendicular to the axis 260

and is in close proximity to the first array 420. A heat transport medium can be attached to the top surface 275 to introduce a heat transfer medium 297 such as air in a direction shown in Figure 2, to create a flow around the core 210 and the first and second arrays 420 and 490 that is substantially parallel to the core 210 and the first and second arrays 420 and 490 to enhance the heat dissipation by the heat dissipation device 400. A heat transport medium 295 such as a heat pipe, or other such medium can be included in the core 210 to further enhance the heat transfer from the heat dissipation device 400.

In some embodiments, the enhanced heat dissipation device 400 is made of thermally conductive materials such as copper, aluminum, or any other such material capable of extracting heat away from the integrated circuit device. In some embodiments, the core 210 can include heat transport mediums such as one or more heat pipes, a liquid, a thermo-siphon, or other similar heat transport medium suitable for enhancing the extraction of heat from the integrated circuit device. In some embodiments, the first and second arrays 420 and 490 occupy a first and second volume of space around the upper and lower surface areas 230 and 240 such that the first volume is less than the second volume to permit components to be mounted on the circuit board 130 and below the first array 420.

Figure 6 is an isometric view of another embodiment of the enhanced heat dissipation device 600 according to the present invention. Shown in Figure 6 is the enhanced heat dissipation device 600 including the thermally conductive core 210, and a first array of radially extending substantially planar fin structures 620. Also, shown in Figure 6 is the core 210 having upper and lower outer surface areas 230 and 240. The first array 620 is thermally coupled to the upper core area 230 of the core 210 such that a cooling medium such as air introduced around the upper and lower surface areas 230 and 240 of the core 210 and the first array 620 creates a flow that is substantially perpendicular to the core 210 to enhance heat dissipation from the device 600. Figure 6 further shows an optional second array of radially extending substantially planar fin structures 690 thermally coupled to the lower core area 240 of the core 210 such that the cooling medium introduced around the first and second arrays 620 and 690 creates a flow that is substantially perpendicular to the core 210 to further enhance heat dissipation from the device 600.

The core 210 has an axis 260. In some embodiments, the upper and lower surface areas 230 and 240 are parallel to the axis 260. The core 210 further has a base 270. In some embodiments, the base 270 is disposed such a way that it is in close proximity to the lower surface area 240 and perpendicular to the axis 260.

The upper and lower surface areas 230 and 240 can be concentric to the axis 260.

The first array 620 is thermally coupled to the upper surface area 230 such that components can be mounted around and in close proximity to the lower surface area 240 and below the first array 620 when the device 600 is mounted onto the integrated circuit device. In some embodiments, the components can encroach onto the integrated circuit device without mechanically interfering with the device 600.

The core 210 can be a solid body. The solid body can be cylindrical, conical, square, rectangular, or any other similar shape that facilitates in mounting onto the integrated circuit device and in attaching the first array 620 to the upper surface area 230. The core 210 can include heat transport mediums such as one or more heat pipes, a liquid, a thermo-siphon, or other such heat transport medium that enhance heat dissipation from the integrated circuit device.

The first array 620 has a first outer diameter 250 and the second array 690 has a second outer diameter 255. The second outer diameter 255 is less than the first outer diameter 250. The first array 620 has a first depth and the second array 690 has a second depth. The first and second outer diameters 250 and 255, including the first and second depths, are of sufficient size to allow components to be mounted around and in close proximity to the integrated circuit device when the device is mounted on the integrated circuit device.

The second array 690 is thermally coupled to the lower core area 240 of the core 210 such that the cooling medium introduced creates an omni-directional flow around the upper and lower surface areas 230 and 240 of the core 210 and the first and second arrays 620 and 690 to enhance heat dissipation from the device 600. The device 600, including the core 210 and the first and second arrays 620 and 690, can be made from materials such as aluminum, copper, or any other materials that are capable of dissipating heat away from the integrated circuit device. The first and second arrays 620 and 690 can be formed to have outer shapes such as circular, square, rectangular, elliptical, conical or any other shape suitable for allowing components to encroach around and in close proximity to the first and second arrays 620 and 690.

Figure 7 is an isometric view 700 showing the enhanced heat dissipation device 600 shown in Figure 6, attached to the microprocessor 120 on an assembled motherboard 130. In the example embodiment shown in Figure 7, the microprocessor 120 has a front side 340 and a back side 330. The front side 340 is disposed across from the back side 330. The front side 340 is attached to the assembled motherboard 130 that has components such as low-cost capacitors 140

and other such electrical components. The base 270 shown in Figure 6, of the enhanced heat dissipation device 600 attached to the back side 330 of the microprocessor 120. It can be seen from Figure 7 that the first and second arrays 620 and 690 are of sufficient size so as to allow low-cost capacitors 140 mounted on the assembled board 130 to encroach around the microprocessor 120. It can also be seen that low-cost capacitors 140 are below the first array 620 and around the second array 690.

Also, it can be seen in Figure 7 that the first array 620 is larger than the second array 690, thereby increasing the heat dissipation rate without increasing the footprint size of the base 270 of the heat dissipation device 200 any more than the back side 330 of the microprocessor 120. The coinciding footprint sizes of the base 270 of the heat dissipation device 200 and the back side 330 of the microprocessor 120 enables the base 270 and the back side 330 of the microprocessor 120 to have the same heat transfer rates. This in turn increases the efficiency of heat transfer between the base 270 and the back side 330 of the microprocessor 120.

A heat transport medium can be disposed around the device 600 to introduce a heat transfer medium 297 such as air in a direction shown in Figure 6, to create a flow that is substantially perpendicular to the core 210. Further, the flow is substantially parallel to the first and second arrays 620 and 690 to enhance the heat dissipation by the heat dissipation device 600. A heat transport medium 295 such as a heat pipe, or other such medium can be included in the core 210 to further enhance the heat transfer from the heat dissipation device 600.

In some embodiments, the enhanced heat dissipation device 600 is made of thermally conductive materials such as copper, aluminum, or any other such material capable of extracting heat away from the integrated circuit device. In some embodiments, the core 210 can include heat transport mediums such as one or more heat pipes, a liquid, a thermo-siphon, or other similar heat transport medium suitable for enhancing the extraction of heat from the integrated circuit device. In some embodiments, the first and second arrays 620 and 690 occupy a first and second volume of space around the upper and lower surface areas 230 and 240 such that the first volume is less than the second volume to permit components to be mounted on the circuit board 130 and below the first array 620

Conclusion

The above-described device and method provides, among other things, enhanced heat dissipation by using an array of radially extending fin structures

where possible. This allows electronic components to encroach around an integrated circuit device on which it is mounted, while maintaining high performance and cost effectiveness by leveraging currently enabled high volume manufacturing techniques

WHAT IS CLAIMED IS:

1. An enhanced heat dissipation device, comprising:

a thermally conductive core, wherein the core has upper and lower outer surface areas; and

a first array of radially extending pin fin structures, the first array being thermally coupled to the upper surface area of the core such that a cooling medium introduced around the upper and lower surface areas of the core and the first array creates an omni-directional flow around the first array and the upper and lower surface areas to enhance heat dissipation.

2. The device of claim 1, wherein the core further has an axis, wherein the upper and lower surface areas are parallel to the axis, wherein the core further has a base, wherein the base is disposed such that it is perpendicular to the axis and in close proximity to the lower surface area, wherein the upper and lower surface areas are concentric to the axis.

3. The device of claim 2, wherein the first array is thermally coupled to the upper surface area such that components can be mounted around and in close proximity to the lower surface area and below the first array when the device is mounted on an integrated circuit device.

4. The device of claim 1, wherein the core has a shape such as cylindrical, conical, square, or rectangular.

5. The device of claim 4, wherein the core includes a heat transport medium such as one or more heat pipes, a liquid, a thermo-siphon, or other similar heat transport medium.

6. The device of claim 1, further comprising:

a second array of radially extending pin fin structures, wherein the second array is coupled to the lower surface area of the core.

7. The device of claim 6, wherein the second array has a size sufficient to allow components to be mounted around and in close proximity to the second array and below the first array when the device is mounted on an integrated circuit device.

8. The device of claim 7, wherein the first and second arrays have an outer shape such as circular, square, rectangular, elliptical, conical, or any other shape suitable for allowing components to encroach around and in close proximity to the first and second arrays.

9. The device of claim 8, wherein the core and the first and second arrays are made from materials such as aluminum, copper, or other such materials capable of extracting heat away from the integrated circuit device.

10. A heat dissipation system, comprising:

an integrated circuit device, having a front side and a back side, wherein the front side is disposed across from the back side, wherein the front side is attached to a circuit board having components;

an enhanced heat dissipation device comprising:

a thermally conductive core, thermally coupled to the back side of the integrated circuit device, the core having upper and lower outer surface areas, wherein the upper and lower surface areas have a first and second length; and

a first array of radially extending pin fin structures, the first array is thermally coupled to the upper surface area such that the first array surrounds the upper surface area, the first length of the first array being sufficient to permit components to be mounted on the circuit board and below the first array.

11. The system of claim 10, wherein the core further comprises a base, wherein the base is in close proximity to the lower surface area, wherein the back side of the integrated circuit device and the base have coinciding footprint sizes so that temperatures of the integrated circuit device, the base, the first array, and the core are substantially close to each other during operation to enhance heat transfer from the integrated circuit device.

12. The heat system of claim 11, further comprising:

a heat transport medium, wherein the core further has a top surface disposed across from the base and in close proximity to the upper surface area, wherein the heat transport medium is attached to the top surface such that a direction of flow of a cooling medium introduced by the heat transfer medium

over the first array of radially extending pin fin structures creates an omni-directional air flow around the core and the first array to enhance heat dissipation from the integrated circuit device.

13. The system of claim 12, further comprising:

a second array of radially extending pin fin structures, the second array is thermally coupled to the lower surface area, the first and second arrays occupying a first and second volume of space around the upper and lower surface areas, respectively, wherein the second volume is less than the first volume and sufficient to permit components to be mounted on the circuit board and below the first array, wherein the direction of flow of the cooling medium introduced by the heat transfer medium over the second array further creates an omni-directional air flow around the core and the second array to enhance heat dissipation from the integrated circuit device.

14. The system of claim 10, wherein the integrated circuit device is a microprocessor.

15. An enhanced heat dissipation device, comprising:

a thermally conductive core, wherein the core has upper and lower outer surface areas, the core has an axis, wherein the upper and lower surfaces are parallel to the axis, wherein the core further has a base, wherein the base is disposed such that it is perpendicular to the axis and in close proximity to the lower surface area; and

a first array of radially extending substantially planar fin structures, the first array being thermally coupled to the upper surface area of the core, wherein the fin structures are substantially parallel to the axis such that a cooling medium introduced around the core and the first array creates a flow direction substantially parallel to the axis and around the upper and lower surface areas to enhance heat dissipation.

16. The device of claim 15, wherein the upper and lower surface areas are concentric to the axis.

17. The device of claim 15, wherein the first array is thermally coupled to the upper surface area such that components can be mounted around and in close

proximity to the lower surface area and below the first array when the device is mounted on an integrated circuit device.

18. The device of claim 15, wherein the core has a shape such as cylindrical, conical, square, or rectangular.

19. The device of claim 18, wherein the core includes a heat transport medium such as one or more heat pipes, a liquid, a thermo-siphon, or other similar heat transport medium.

20. The device of claim 15, further comprising:
a second array of radially extending substantially planar fin structures, wherein the second array is coupled to the lower surface area of the core, wherein the fin structures of the second array are substantially parallel to the axis such that a cooling medium introduced around the core and the second array creates a directional flow substantially parallel to the axis and around the upper and lower surface areas to enhance heat dissipation.

21. The device of claim 20, wherein the second array has a size sufficient to allow components to be mounted around and in close proximity to the second array and below the first array when the device is mounted on an integrated circuit device.

22. The device of claim 20, wherein the fin structures of the first and second arrays are aligned and attached to form a single array.

23. The device of claim 21, wherein the first and second arrays have an outer shape such as circular, square, rectangular, elliptical, conical, or any other shape suitable for allowing components to encroach around and in close proximity to the first and second arrays.

24. The device of claim 23, wherein the core and the first and second arrays are made from materials such as aluminum, copper, or other such materials capable of extracting heat away from the integrated circuit device.

25. A heat dissipation system, comprising:
an integrated circuit device, having a front side and a back side, wherein the

front side is disposed across from the back side, wherein the front side is attached to a circuit board having components;

an enhanced heat dissipation device comprising:

a thermally conductive core, wherein the core has upper and lower outer surfaces, the core has an axis, wherein the upper and lower surface areas are parallel to the axis, wherein the core further has a base, wherein the base is disposed perpendicular to the axis, wherein the base is thermally coupled to the back side of the integrated circuit device, wherein the upper and lower surface areas have a first and second length; and

a first array of radially extending substantially planar fin structures, the first array is thermally coupled to the upper surface area such that the first array surrounds the upper surface area, wherein the fin structures are substantially parallel to the axis such that a cooling medium introduced around the core has a flow direction substantially parallel to upper and lower surface areas to enhance heat dissipation from the integrated circuit device, the first length of the first array being sufficient to permit components to be mounted on the circuit board and below the first array.

26. The system of claim 25, wherein the base is in close proximity to the lower surface area, the back side of the integrated circuit device and the base have coinciding footprint sizes so that temperatures of the integrated circuit device, the base, the first array, and the core are substantially close to each other during operation to enhance heat transfer from the integrated circuit device.

27. The heat system of claim 26, further comprising:

a heat transport medium, wherein the core further has a top surface disposed across from the base and in close proximity to the upper surface area, wherein the heat transport medium is attached to the top surface such that a cooling medium introduced by the heat transfer medium over the first array of radially extending substantially planar fin structures creates flow direction substantially parallel to upper and lower surface areas to enhance heat dissipation from the integrated circuit device from the integrated circuit device.

28. The system of claim 27, further comprising:

a second array of radially extending substantially planar fin structures, the second array is thermally coupled to the lower surface area, the fin structures of the second array are substantially parallel to the axis, the first and second arrays

occupying a first and second volume of space around the upper and lower surface areas, respectively, wherein the second volume is less than the first volume and sufficient to permit components to be mounted on the circuit board and below the first array, wherein the direction of flow of the cooling medium introduced by the heat transfer medium over the second array further creates an air flow substantially parallel to the axis and around the upper and lower surface areas to enhance heat dissipation from the integrated circuit device.

29. The system of claim 15, wherein the integrated circuit device is a microprocessor.

30. An enhanced heat dissipation device, comprising:

a thermally conductive core, wherein the core has upper and lower outer surface areas, the core has an axis, wherein the upper and lower surfaces are parallel to the axis, wherein the core further has a base, wherein the base is disposed such that it is perpendicular to the axis and in close proximity to the lower surface area; and

a first array of radially extending substantially planar fin structures, the first array being thermally coupled to the upper surface area, wherein the fin structures are substantially perpendicular to the axis such that a cooling medium introduced around the core and the first array creates a flow direction substantially perpendicular to the axis and around the upper and lower surface areas to enhance heat dissipation.

31. The device of claim 30, wherein the first array is thermally coupled to the upper surface area such that components can be mounted around and in close proximity to the lower surface area and below the first array when the device is mounted on an integrated circuit device.

32. The device of claim 30, wherein the core has a shape such as cylindrical, conical, square, or rectangular.

33. The device of claim 32, wherein the core includes a heat transport medium such as one or more heat pipes, a liquid, a thermo-siphon, or other similar heat transport mediums.

34. The device of claim 30, further comprising:

a second array of radially extending substantially planar fin structures, wherein the second array is coupled to the lower surface area of the core, wherein the fin structures of the second array are substantially perpendicular to the axis such that a cooling medium introduced around the core and the second array creates a flow direction substantially perpendicular to the axis and around the upper and lower surface areas to enhance heat dissipation.

35. The device of claim 34, wherein the second array has a size sufficient to allow components to be mounted around and in close proximity to the second array and below the first array when the device is mounted on an integrated circuit device.

36. The device of claim 35, wherein the first and second arrays have an outer shape such as circular, square, rectangular, elliptical, conical, or any other shape suitable for allowing components to encroach around and in close proximity to the first and second arrays.

37. The device of claim 36, wherein the core and the first and second arrays are made from materials such as aluminum, copper, or other such materials capable of extracting heat away from the integrated circuit device.

38. A heat dissipation system, comprising:

an integrated circuit device, having a front side and a back side, wherein the front side is disposed across from the back side, wherein the front side is attached to a circuit board having components;

an enhanced heat dissipation device comprising:

a thermally conductive core, wherein the core has upper and lower outer surface areas, the core has an axis, wherein the upper and lower surface areas are parallel to the axis, wherein the core further has a base, wherein the base is disposed perpendicular to the axis, wherein the base is thermally coupled to the back side of the integrated circuit device, wherein the upper and lower surface areas have a first and second length; and

a first array of radially extending substantially planar fin structures, the first array is thermally coupled to the upper surface area such that the first array surrounds the upper surface area, wherein the fin structures are substantially perpendicular to the axis such that a cooling medium introduced around the core

has a directional flow substantially perpendicular to upper and lower surface areas to enhance heat dissipation from the integrated circuit device, the first length of the first array being sufficient to permit components to be mounted on the circuit board and below the first array.

39. The system of claim 38, wherein the base is in close proximity to the lower surface area, the back side of the integrated circuit device and the base have coinciding footprint sizes so that temperatures of the integrated circuit device, the base, the first array, and the core are substantially close to each other during operation to enhance heat transfer from the integrated circuit device.

40. The heat system of claim 39, further comprising:

a heat transport medium, wherein the heat transport medium is disposed around the device such that a cooling medium introduced by the heat transport medium around the first array creates a flow around the core and the first array such that the flow is substantially perpendicular to the axis to enhance the heat dissipation from the integrated circuit device.

41. The system of claim 40, further comprising:

a second array of radially extending substantially planar fin structures, the second array is thermally coupled to the lower surface area, the fin structures of the second array are substantially perpendicular to the axis, the first and second arrays occupying a first and second volume of space around the upper and lower surface areas, respectively, wherein the second volume is less than the first volume and sufficient to permit components to be mounted on the circuit board and below the first array, wherein the direction of flow of the cooling medium introduced by the heat transfer medium over the second array further creates an air flow substantially perpendicular to the axis and around the upper and lower surface areas.

42. The system of claim 38, wherein the integrated circuit device is a microprocessor.

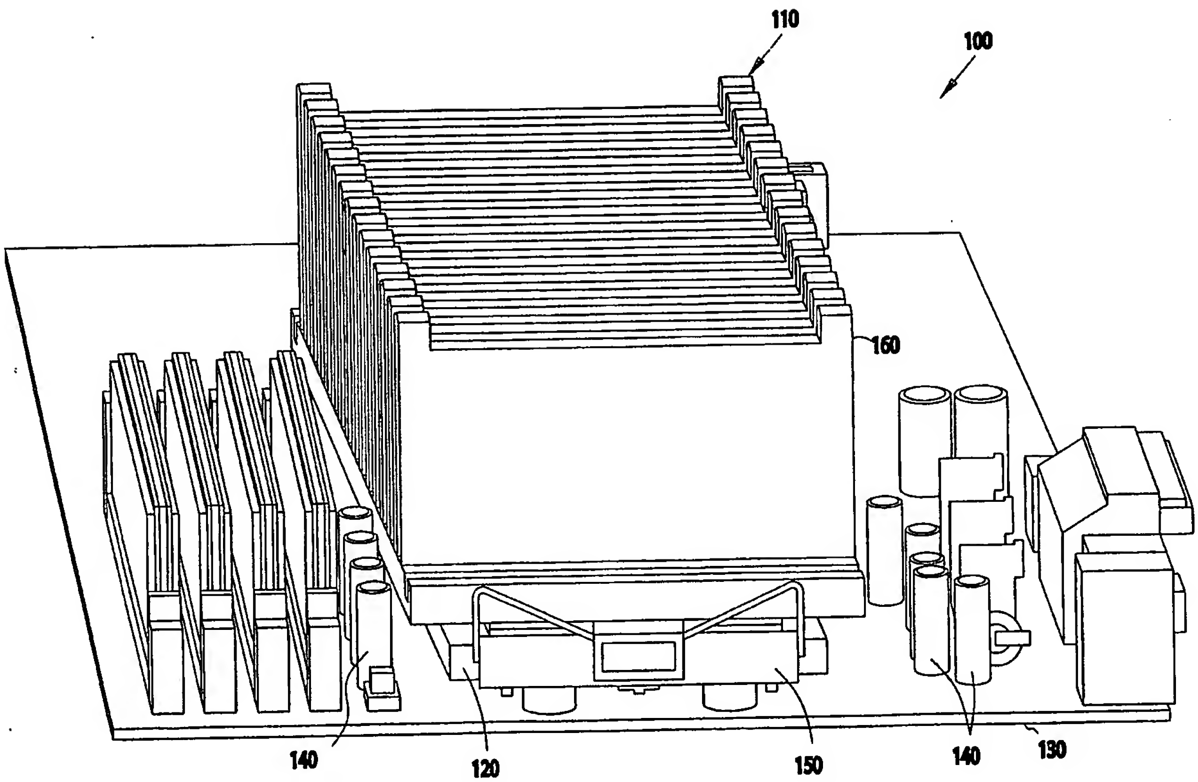

FIG. 1
(PRIOR ART)

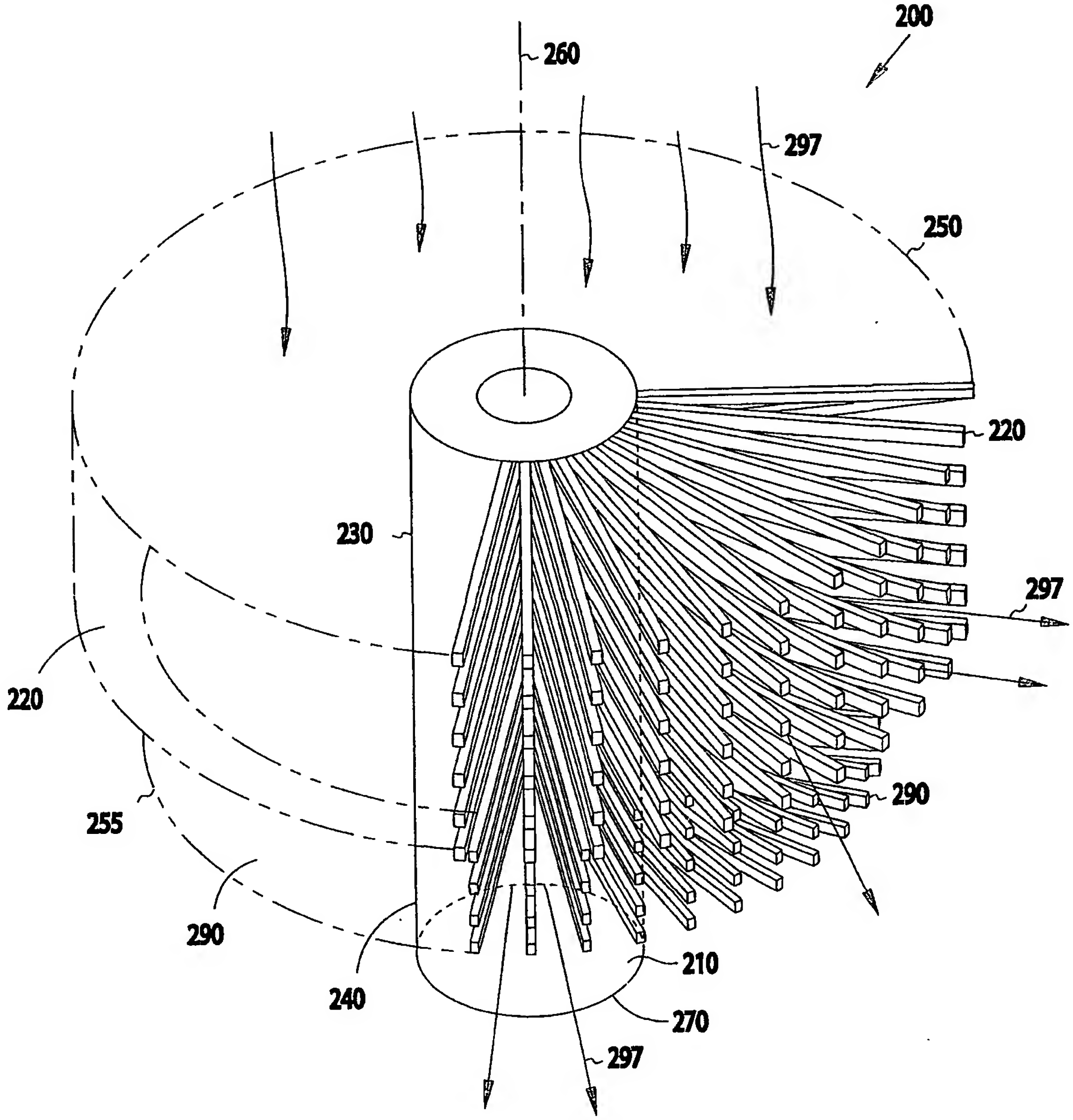

FIG. 2

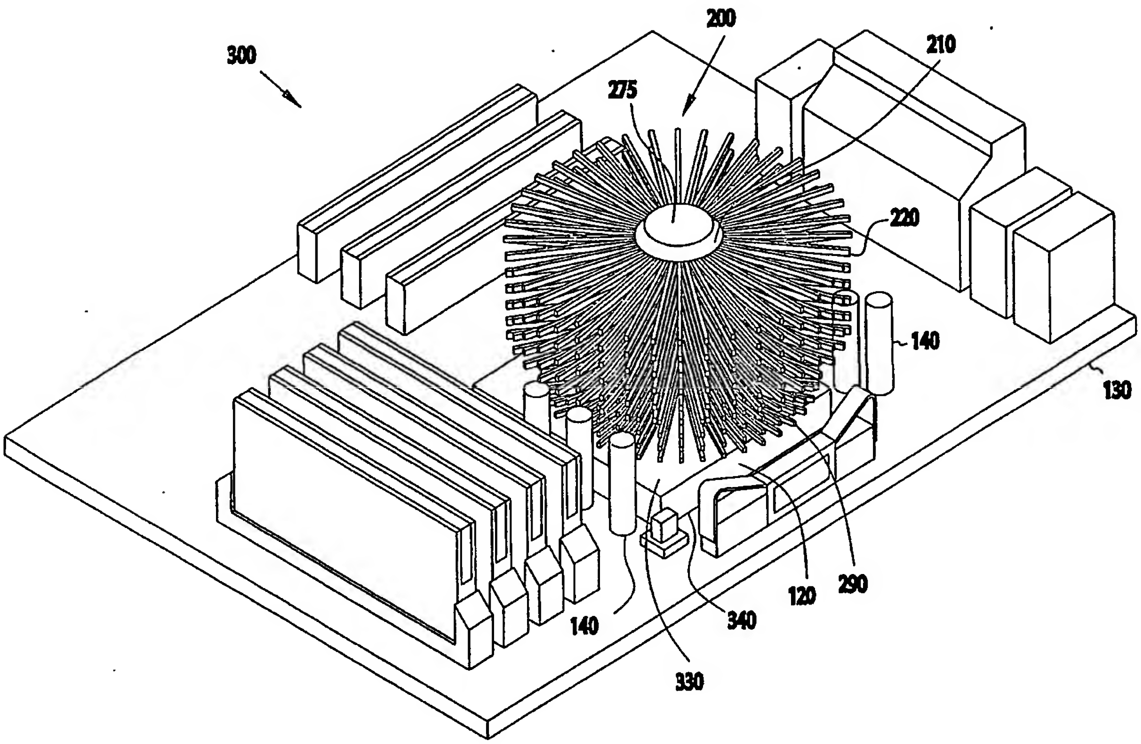

FIG. 3

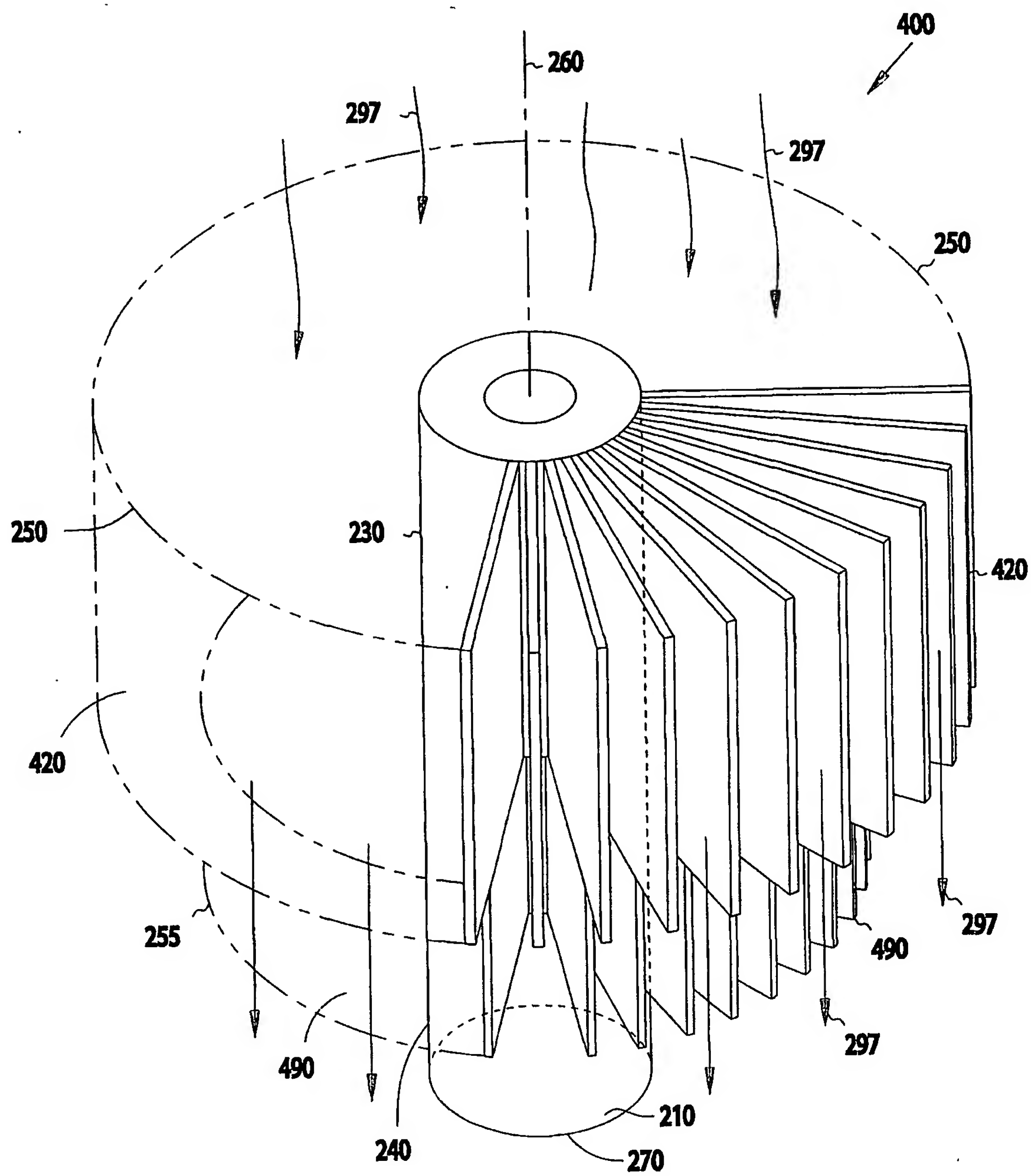
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FIG. 4

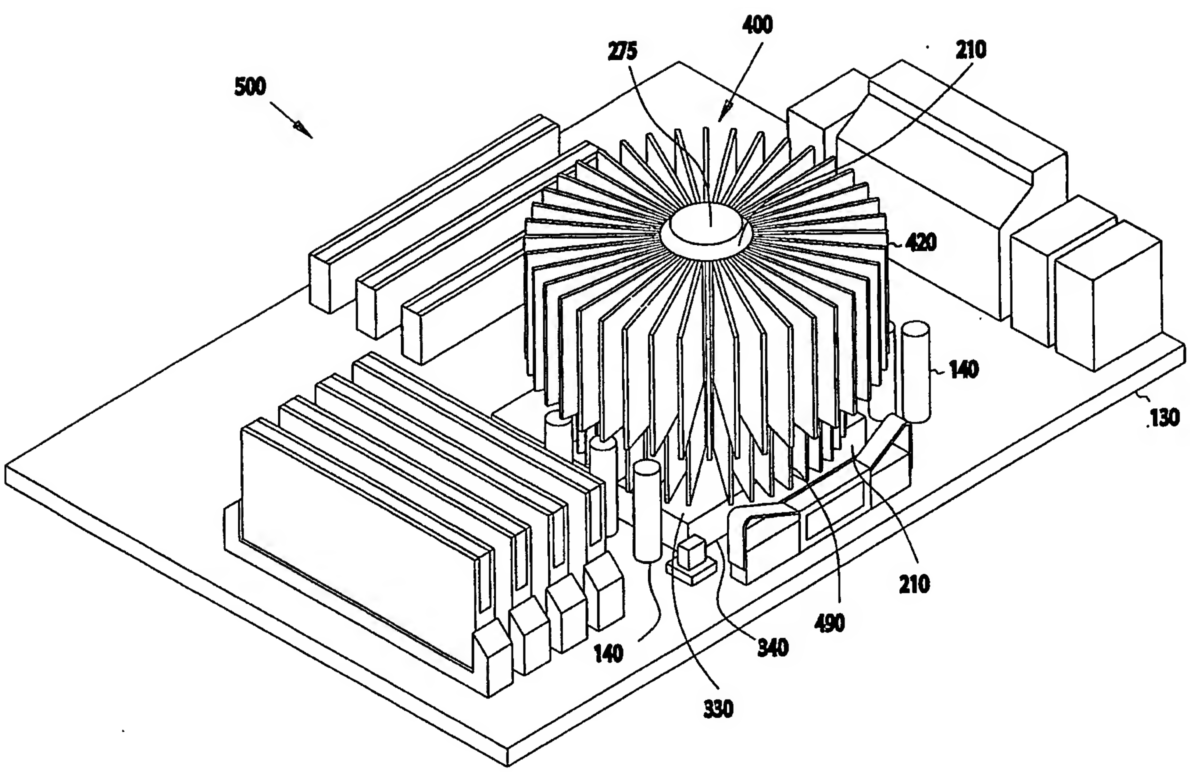

FIG. 5

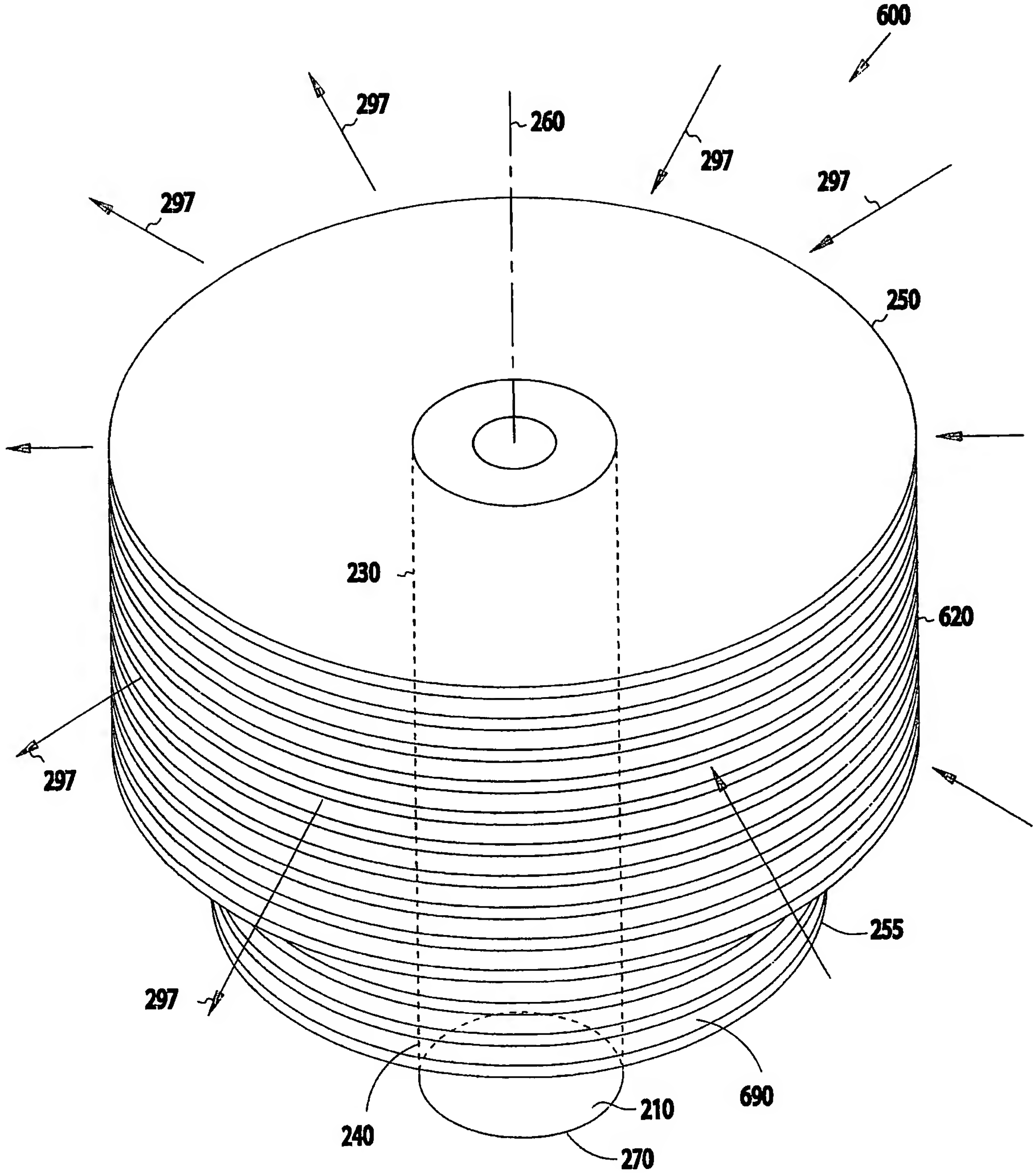

FIG. 6

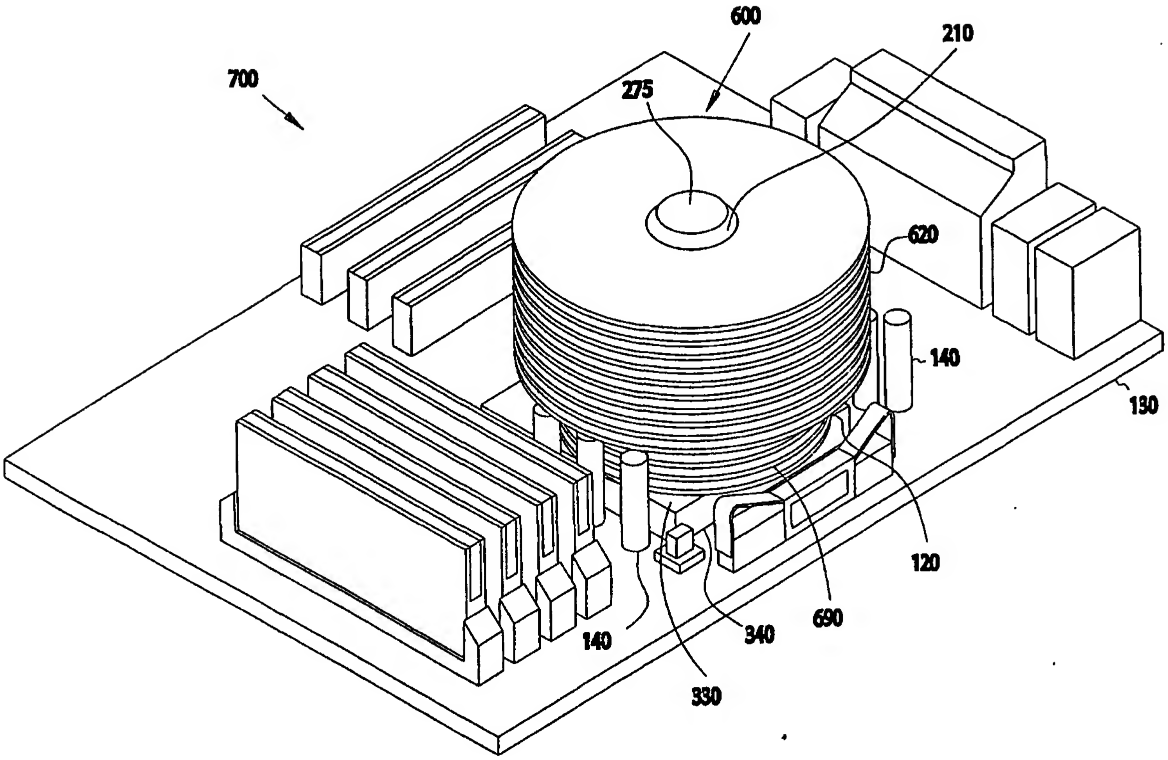

FIG. 7